

006.39 Mathematics

006.39A Grade Levels: ~~7~~6-12.

006.39B Endorsement Type: Field.

006.39C Persons with this endorsement may teach mathematics in grades ~~7~~ 6 through 12.

006.39D Certification Endorsement Requirements: This endorsement shall require a minimum of ~~30~~ 36 semester hours of mathematics.

006.39E Endorsement Program Requirements: Nebraska teacher education institutions offering this endorsement program must have on file, within the institution, a plan which identifies the courses and the course completion requirements which the institution utilizes to grant credit toward completion of this endorsement.

***THE FOLLOWING ARE RECOMMENDED GUIDELINES FOR  
INCLUSION AS PART OF THE INSTITUTION'S PLAN  
UNDER THIS ENDORSEMENT.***

Through the courses identified in its plan, the institution ~~should~~ will prepare prospective teachers ~~to demonstrate the following criteria~~ according to the 2012 standards of the National Council of Teachers of Mathematics (NCTM) to:

**A.** Demonstrate knowledge and understanding of and ~~be able~~ ability to teach the concepts, skills, and processes of mathematics as defined in the Nebraska Content Standards for eighth and twelfth grades as per NAC 92 Rule 10.

**B. (NCTM) Standard 1. Content Knowledge.** Effective teachers of secondary mathematics understand and demonstrate knowledge of major mathematics concepts, algorithms, procedures, connections, and applications within the major content domains of mathematics. They understand the influence of curriculum standards on the mathematical content knowledge needed for teaching secondary (6-12) students.

Preservice teacher candidates:

- 1.a) Understand major mathematics concepts, algorithms, procedures, applications in varied contexts, and connections between and among the major content domains of mathematics as outlined in the NCTM Content Analysis (listed below); and
- 1.b) Demonstrate an understanding of curriculum standards for mathematics

and their impact on the mathematical content knowledge necessary for teaching secondary students.

All secondary mathematics teachers are prepared with depth and breadth in the following mathematical domains: Algebra, Number Theory, Geometry, Trigonometry, Probability, Statistics, Discrete Mathematics, and Calculus. All teachers certified in secondary mathematics will know, understand, and teach with the breadth of understanding reflecting the following competencies for each of these domains:

1. **Number and Quantity.** All secondary mathematics teachers are prepared to develop student understanding of the following number and quantity concepts:
  - 1.1 Structure, properties, relationships and operations on various types of numbers and number systems, including integers, rationals, irrationals, reals, and complex numbers;
  - 1.2 Quantitative reasoning and relationships that include ratio, rate, and proportion and the use of units in problem situations;
  - 1.3 Operations, modeling, and applications involving vector and matrix quantities;
  - 1.4 Utilization of technological tools to explore number and quantity; and
  - 1.5 Historical development and perspectives of number, number systems, and quantity including contributions of significant figures and diverse cultures.
2. **Algebra.** All secondary mathematics teachers are prepared to develop student understanding of the following algebra concepts:
  - 2.1 Expressions, equations, and inequalities used to describe, interpret, and model relationships;
  - 2.2 Function classes including polynomial, exponential and logarithmic, rational, periodic, and discrete used to determine how parameters determine particular cases and model situations;
  - 2.3 Functional representations and notations as a means to describe, interpret, and analyze relationships and to build new functions;
  - 2.4 Vectors, matrices, and transformations;
  - 2.5 Groups, rings, and fields and the relationship between these structures and formal structures of number systems and numerical and symbolic calculations;
  - 2.6 Utilization of technological tools to explore algebraic ideas, individual functions, and classes of related functions and to solve problems; and

- 2.7 Historical development and perspectives of algebra including contributions of significant figures and diverse cultures.
3. **Geometry and Trigonometry.** All secondary mathematics teachers are prepared to develop student understanding of the following geometry and trigonometry concepts:
- 3.1 Core principles of Euclidean geometry in two and three dimensions and examples of non-Euclidean geometry;
  - 3.2 Transformations, congruence, and vector representations;
  - 3.3 Similarity, right triangles, and trigonometry from a geometric perspective;
  - 3.4 Analytic and coordinate geometry including algebraic proofs, equations of lines and planes in space, and expressing geometric properties of conic sections with equations;
  - 3.5 Visualization, representation, and measurement of two- and three-dimensional objects;
  - 3.6 Geometric constructions, axiomatic reasoning, and proof;
  - 3.7 Application of periodic phenomena and trigonometric identities;
  - 3.8 Utilization of concrete models and dynamic technological tools to conduct geometric and trigonometric investigations that emphasize visualization, pattern recognition, conjecturing, and proof and to model and solve problems; and
  - 3.9 Historical development and perspectives of geometry and trigonometry including contributions of significant figures and diverse cultures.
4. **Statistics and Probability.** All secondary mathematics teachers are prepared to develop student understanding of the following statistics and probability concepts:
- 4.1 Creation and implementation of surveys and investigations using sampling methods and statistical designs, statistical inference (estimation of population parameters and hypotheses testing), justification of conclusions, and generalization of results;
  - 4.2 Construction and interpretation of graphical displays of univariate data distributions; summary measures and comparison of distributions of univariate data, and exploration of bivariate and categorical data;
  - 4.3 Continuous and discrete probability, conditional probability, and combinatorial techniques;
  - 4.4 Random phenomena, simulations, and probability distributions and their application as models of real phenomena and decision making;

- 4.5 Utilization of technological tools to explore statistical ideas, represent information, and solve problems; and
  - 4.6 Historical development and perspectives of statistics and probability including contributions of significant figures and diverse cultures.
  - 5. **Calculus.** All secondary mathematics teachers are prepared to develop student understanding of the following calculus concepts:
    - 5.1 Limit, continuity, and the techniques and applications of differentiation and integration;
    - 5.2 Parametric, polar, and vector functions; sequences and series;
    - 5.3 Applications of function, geometry, and trigonometry concepts to solve problems involving calculus;
    - 5.4 Utilization of technological tools to explore and represent fundamental concepts of calculus and to solve problems taken from real-world contexts; and
    - 5.5 Historical development and perspectives of calculus including contributions of significant figures and diverse cultures.
  - 6. **Discrete Mathematics.** All secondary mathematics teachers are prepared to develop student understanding of the following discrete mathematics concepts:
    - 6.1 Graphs, trees, and networks;
    - 6.2 Finite differences, iteration, recursion, linear programming, and combinatorics;
    - 6.3 Discrete structures (sets, logic, relations, and functions) and their applications in the design of data structures and programming;
    - 6.4 Utilization of technological tools to solve problems involving discrete structures, the application of algorithms, and programming; and
    - 6.5 Historical development and perspectives of discrete mathematics including contributions of significant figures and diverse cultures.
- C. (NCTM) Standard 2: Mathematical Practices.** Effective teachers of secondary mathematics know and understand the importance of problem solving, reasoning and proof, modeling, attending to precision, identifying elements of structure, generalizing, engaging in mathematical communication, and making connections as essential mathematical practices. They understand that these practices intersect with mathematical content and that understanding of mathematical content relies on the ability to demonstrate these practices within each of the content domains.

Preservice teacher candidates:

- 2.a) Use problem solving to develop conceptual understanding, make sense of of a wide variety of problems and persevere in solving them, apply and adapt a variety of strategies in solving problems confronted within the field of mathematics and other contests, and formulate and test generalizations.
- 2.b) Reason abstractly, reflectively, and quantitatively with attention to units, constructing viable arguments and proofs, and critiquing the reasoning of others; represent and model generalizations using mathematics; recognize structure and express regularity in patterns of mathematical reasoning; and use multiple representations to model and describe mathematics.
- 2.c) Formulate, represent, analyze, interpret, and validate mathematical models derived from real-world contexts or mathematical problems.
- 2.d) Organize mathematical thinking and utilize appropriate mathematical vocabulary and symbols to express ideas orally, pictorially, and in writing to diverse audiences. (Original wording is “multiple audiences”)
- 2.e) Demonstrate the interconnectedness of mathematical ideas and how they build on one another and recognize and apply mathematical connections between and among mathematical ideas and across various content areas and real-world contexts.

**D. (NCTM) Standard 3. Content Pedagogy.** Effective teachers of secondary mathematics incorporate research-based mathematical experiences and include multiple instructional strategies in their teaching to develop students’ mathematical understanding and proficiency. They provide students with opportunities to do mathematics – talking about it and connecting it to both school and real-world contexts. They design formative and summative assessments for monitoring student learning, measuring student mathematical understanding, and informing practice.

Preservice teacher candidates:

- 3.a) Analyze and consider research in planning for and leading students in rich mathematical experiences;
- 3.b) Plan lessons and units incorporating a variety of strategies, differentiated instruction for diverse populations, and mathematics-specific and instructional technologies to build all students’ conceptual understanding and procedural fluency; (original word was proficiency)
- 3.c) Provide **all** students opportunities to communicate about mathematics and make connections among mathematics, other content areas, everyday life, and the workplace;

- 3.d) Implement techniques related to student engagement and communication including selecting high quality tasks, identifying student misconceptions, and employing a range of questioning strategies;
- 3.e) Plan and select formative and summative assessments reflecting mathematical knowledge, skills, understanding, and performance that are essential for students;
- 3.f) Monitor **all** students' progress, make instructional decisions, and measure **all** students' mathematical understanding and ability using formative and summative assessments.

**E. (NCTM) Standard 4. Mathematical Learning Environment.** Effective teachers of secondary mathematics have an in-depth knowledge of adolescent development and behavior and use this knowledge to create learning opportunities grounded in mathematics education research where students are actively engaged in the mathematics they are learning. They demonstrate a positive disposition toward mathematical practices and learning, include culturally relevant perspectives in teaching, demonstrate equitable and ethical treatment of and have high expectations for all students, and use manipulatives, digital tools, and virtual resources to enhance learning while recognizing the possible limitations of such tools.

Preservice teacher candidates:

- 4.a) Possess an in-depth knowledge of adolescent development and behavior and demonstrate a positive disposition toward mathematical processes and learning;
- 4.b) Create developmentally appropriate and challenging learning opportunities grounded in mathematics education research in which **all** students are actively engaged in building new knowledge;
- 4.c) Recognize individual differences and the cultural diversity that exists within classrooms and incorporate culturally relevant perspectives as tools to motivate and engage students;
- 4.d) Demonstrate equitable and ethical treatment of and have high expectations for all students;
- 4.e) Apply mathematical content and pedagogical knowledge to select and use tools such as manipulatives and physical models, drawings, virtual environments, spreadsheets, presentation tools, and technology; and make sound decisions about when such tools enhance teaching and learning, recognizing both the insights to be gained and possible limitations of such tools.

**F. (NCTM) Standard 5. Impact on Student Learning.** Effective teachers of secondary mathematics provide evidence demonstrating that as a result of their instruction, secondary students' conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, productive disposition toward mathematics, and application of major mathematics concepts in varied contexts have increased and that new student mathematical knowledge has been created.

Preservice teacher candidates:

- 5.a) Collect, organize, analyze, reflect, and provide data on diagnostic, formative, and summative assessment evidence and determine the extent to which students' mathematical knowledge, skills, understandings, and performance have increased; and
- 5.b) Analyze, reflect, and provide data that students have built new knowledge by their engagement in developmentally appropriate mathematical activities and investigations that include technology.

**G. (NCTM) Standard 6. Professional Knowledge and Skills.** Effective teachers of secondary mathematics are lifelong learners and recognize that learning is often collaborative. They participate in professional development experiences specific to mathematics and mathematics education, draw upon mathematics education research to inform practice, continuously reflect on their practice, and utilize resources from professional mathematics organizations.

Preservice teacher candidates:

- 6.a) Take an active role in their professional growth by participating in professional development experiences that directly relate to the learning and teaching of mathematics;
- 6.b) Engage in continuous and collaborative learning that draws upon research in mathematics education to inform practice; enhance all students' knowledge of mathematics; involve colleagues; school professionals, families, and other stakeholders;
- 6.c) Utilize print, digital, and virtual resources and collections of professional mathematics education organizations; and
- 6.d) Work collaboratively with others to enhance all students' knowledge of mathematics; while developing as a reflective practitioner.



- ~~B. Demonstrate an understanding of and be able to apply the processes of mathematics, including being able to:~~
- ~~1. Use problem-solving approaches to investigate and understand mathematical content;~~
  - ~~2. Formulate and solve problems from both mathematics and everyday situations;~~
  - ~~3. Communicate mathematical ideas orally and in writing using everyday language, mathematical language, symbols, and graphs;~~
  - ~~4. Make mathematical conjectures, evaluate arguments and validate mathematical thinking;~~
  - ~~5. Examine relationships within mathematics;~~
  - ~~6. Connect mathematics to other disciplines and real-world situations;~~
  - ~~7. Use technology in exploration, computation, graphing, and problem solving; and~~
  - ~~8. Use instructional strategies based on current research as well as national, state, and local standards relating to mathematics instruction.~~

~~Demonstrate an understanding of and be able to apply the concepts and principles of mathematics, including being able to:~~

- ~~7. Apply concepts of number, number theory, and number systems;~~
- ~~8. Apply numerical computation and estimation techniques and extend them to algebraic expressions;~~
- ~~9. Use geometric concepts and relationships to describe and model mathematical ideas and real-world constructs;~~
- ~~10. Use both descriptive and inferential statistics to analyze data, make predictions, and make decisions;~~
- ~~11. Demonstrate an understanding of the concepts of theoretical and simulated probability and apply them to real-world situations;~~
- ~~12. Use algebra to describe patterns, relations, and functions and to model and solve problems;~~
- ~~13. Recognize the roles of axiomatic systems and proofs in different branches of mathematics, such as algebra and geometry;~~
- ~~14. Demonstrate an understanding of the concepts of limit, continuity, differentiation, and integration, and the techniques and applications of calculus;~~



- ~~15. Demonstrate an understanding of the concepts and applications of discrete mathematics such as graph theory, matrices, recurrence relations, linear programming, difference equations, and combinatorics;~~
- ~~16. Use mathematical modeling to solve problems from other fields such as natural sciences, social sciences, business, and engineering;~~
- ~~17. Demonstrate an understanding of and be able to apply the major concepts of geometry;~~
- ~~18. Demonstrate an understanding of and be able to apply the major concepts of linear algebra;~~
- ~~19. Demonstrate an understanding of and be able to apply the major concepts of abstract algebra; and~~
- ~~20. Demonstrate an understanding of the historical development in mathematics that includes the contributions of under-represented groups and diverse cultures.~~
- ~~B. The program for prospective teachers may include the following coursework: Pre-calculus, Calculus, Logic/Foundations, Linear Algebra, College Geometry, Probability and Statistics, Discrete/Finite Mathematics, History of Mathematics, Abstract Algebra, and Computer Programming and Applications.~~

## MATHEMATICS AD HOC MEMBERSHIP FORM

(Based on Section 17.03 of the NCTE Organizational Policies)

**Thursday, February 16, 2012—10 AM-4 PM Country Inn & Suites, Lincoln—  
Lighthouse Room**

MEMBERSHIP CRITERIA	NOMINEES
17.03A Three practitioners currently endorsed and employed in approved or accredited public or private schools in the endorsement area under consideration	1. Shelby Aaberg—Scottsbluff High School (D7) <a href="mailto:saaberg@sbps.net">saaberg@sbps.net</a> 2. Helen Banzhaf—Seward High School (D5) <a href="mailto:Helen.banzhaf@connectseward.org">Helen.banzhaf@connectseward.org</a> 3. Tami Heiser, Santee Public (D3) (Could not attend—illness) <a href="mailto:theiser@esu1.org">theiser@esu1.org</a>
17.03B At least two faculty members from a college or department of education who are teaching professional education courses at an approved professional training institution	1. Tami Worner, WSC (D3) <a href="mailto:taworne1@wsc.edu">taworne1@wsc.edu</a> 2. Elliott Ostler, UNO (D8) <a href="mailto:elliottostler@mail.unomaha.edu">elliottostler@mail.unomaha.edu</a>
17.03C Two specialists in the area which might include academic college professors, learned society officers, or persons drawn from related professions	1. JaLena Slack—ESU 8 (D6) <a href="mailto:jslack@esu8.org">jslack@esu8.org</a> 2. Beth Wentworth—CSC (D7) <a href="mailto:bwentworth@csc.edu">bwentworth@csc.edu</a>
17.03D Two teachers currently employed and endorsed in approved or accredited public or private schools at the grade levels and/or subject matter under consideration	1. Cherrie (Cummings) Kerr—Fremont High School (D3) <a href="mailto:Cherrie.kerr@fpsmail.org">Cherrie.kerr@fpsmail.org</a> 2. Otis Pierce—Sutherland High School (D7) <a href="mailto:otis.pierce@spsssailors.org">otis.pierce@spsssailors.org</a>

17.03E Two school administrators currently employed in approved or accredited public or private schools at the grade levels under consideration. At least one of the administrators must represent District Classes 2 or 3	1. Lincoln or Omaha administrators Jim Harrington, OPS Mathematics Supervisor (D4) <a href="mailto:James.Harrington@ops.org">James.Harrington@ops.org</a> 2. Classes 2 or 3 Dick Meyer, Kearney Public (D6) (Could not attend—illness) <a href="mailto:Dick.meyer@kearneypublic.org">Dick.meyer@kearneypublic.org</a>
17.03F One person representing the general public, e.g. PTA member or a school board member	De Tonack, Lincoln (D1) <a href="mailto:dttonack@neb.rr.com">dttonack@neb.rr.com</a>
17.03G One member of the NCTE Undergraduate or Graduate Committee, whichever is applicable.	(Anna) Chris Gay, LPS (D1) <a href="mailto:agay@lps.org">agay@lps.org</a>
17.03H One representative of NDE	Deb Romanek (D1) <a href="mailto:deb.romanek@nebraska.gov">deb.romanek@nebraska.gov</a>
17.03I Additional representatives if it is a field endorsement containing multiple subject endorsements	N/A for this Ad Hoc
17.03J Additional approved or accredited public or private school practitioners or higher education faculty members to equalize the representation between these two groups	Pari Ford, UNK (D6) <a href="mailto:fordpl@unk.edu">fordpl@unk.edu</a> Janice Rech, UNO (D8) <a href="mailto:jrech@nail.unomaha.edu">jrech@nail.unomaha.edu</a> Dave Fowler, UN-L (retired) (D1) <a href="mailto:fowlerdnmi@gmail.com">fowlerdnmi@gmail.com</a> Kass Rempp, Hastings College (D6) <a href="mailto:krempp@hastings.edu">krempp@hastings.edu</a> Jim Johnson, Doane College (D5) <a href="mailto:Jim.johnson@doane.edu">Jim.johnson@doane.edu</a> Julie (Brandt) Lodes, Plattview High School (D2) <a href="mailto:jlodes@sarpy46.org">jlodes@sarpy46.org</a>
17.03K The NDE designee, who will be a non-voting member and serve as a consultant for the committee	Marge Harouff, NDE Consultant Sharon Katt, NDE Pat Madsen, NDE, Marlene Beiermann, NDE

**Ad Hoc Discussion Notes:**

Ad Hoc Committee recommends changing grade level of this endorsement to 6-12, because of mathematics concepts now being taught at 6<sup>th</sup>-8<sup>th</sup> grade levels, National Council of Teachers of Mathematics also recommends 6-12. Currently, a NE-endorsed 7-12 teacher can teach 6<sup>th</sup> grade courses (Rule 10 accreditation.)

Credit hours: Changed minimum requirement from 30 to 36 credit hours (beginning with Calculus II.)

Candidates must be prepared to teach according to NCTM Standards and also the NE Content Standards for grades 6-12. Candidates should also be familiar with K-5 NE Content Standards. (NE has not yet adopted the Common Core Standards.) Preparation programs should be standardized for all candidates, since there are now state and national student mathematics standards for all grades.

Ad Hoc Committee went through each standard and made few revisions in language (2/7/2012 version is now used). NCTM Standards are still in draft form and are to be approved by NCTM in April, 2012 and then adopted by NCATE in October, 2012. The Ad Hoc Committee did agree that if there were changes

Ad Hoc Committee—February 16, 2012

DRAFT # 1

DRAFT #2—February 17, 2012

DRAFT #3—February 29, 2012

**REDLINE VERSION**

**Mathematics  
Endorsement Guidelines  
To Accompany Rule 24  
(Adopted by the State Board  
of Education on 11/9/01)**

in the NCTM Standards after April, they should also be reflected in the Guidelines and the Ad Hoc members would be notified.

Discussion also included how many calculus courses should be required, with the final decision being that Calculus III did not need to be a program requirement for preparation programs for teaching secondary mathematics. With the numbers of college students having to take remedial mathematics courses in college, perhaps more preparation needs to include teaching strategies and methods, especially for students who struggle with mathematics.

Professional development of mathematics teachers was also discussed. Very few mathematics teachers get their masters degree in mathematics. Candidates tend to get their masters degrees in Curriculum and Instruction or Administration, which is somewhat of a problem for the mathematics field.